U.S. Fish & Wildlife Service

Standards
for
Wetlands, Deepwater and Related Habitat Mapping

Part 1 - National Standards and Quality Requirements

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DRAFT

U.S. Fish and Wildlife Service
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I. QUALITY CONTROL CONCEPTS AND RATIONALE

There is an ever growing importance and sensitivity attached to data quality and integrity in the Federal Government, including administrative requirements for information technology systems, computer systems and internet security. Both the Department of the Interior and the Fish and Wildlife Service published Information Quality Guidelines. The Service produced step-down Information Quality Guidelines (FWS 2002) to ensure the quality, objectivity and integrity of information disseminated by the agency. These guidelines are applicable to all Service offices that disseminate information to the public.

"Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs" (ANSI/ASQC E4 1994) is a national consensus standard authorized by the American National Standards Institute (ANSI). It was developed by the American Society for Quality (ASQ) and provides a basis for planning, implementing, documenting, and assessing an effective quality system for collecting and evaluating environmental data (EPA 2000). This provides a recognized and accepted framework for a quality control plan that can be used to ensure that Service programs and decisions are supported by data of the type and quality needed.

It is clear from these guidelines that a system for quality assurance is needed for those Service programs that collect, analyze, report and distribute scientific information. This document provides the Service's mission and goals for inventorying wetlands, deepwater and related habitats. It contains the standards to be used, discusses program limitations, establishes requirements for data quality and provides mechanisms for quality control implementation.

II. PROGRAM MISSION AND GOALS

The U. S. Fish and Wildlife Service's mission is to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people. In the mid 1970s, the Service established the National Wetlands Inventory to provide resource managers with information on the location, extent and types of wetland and deepwater habitats. The Emergency Wetlands Resources Act of 1986 [16 U.S.C. 3931(a)] and its subsequent amendments, gave the Service specific goals and deadlines for producing hard copy and digital wetland maps for the conterminous United States, Alaska, Hawaii, and its Trust Territories. The principal focus was to produce **topical wetland maps that are graphic representations of the type, size and location of all surface waters in the United States (wetlands and deepwater habitats)**. Today, however, the Service faces difficult natural resource management challenges that did not exist when the inventory was created. A new strategy was developed to increase the availability and application of digital map information for natural resources planning and management in support of the Service's conservation programs (USFWS 2002). **The present goal of the National Wetlands Inventory is to provide the citizens of the United States and its Trust Territories with current geospatially referenced information on the status, extent, characteristics and functions of wetlands, riparian, deepwater and related aquatic habitats**

in priority areas to promote the understanding and conservation of these resources.

Within this context, the objective of mapping wetlands and deepwater habitats remains to produce reconnaissance level information[1] on the location, type, size of these habitats such that they are accurate at the nominal scale of the 1:24,000 base map, and the 1:63,360 base map for Alaska. The Service recognized the limitations of using remotely sensed information as the primary data source, and additionally, by policy, excluded some wetland types from its inventory (see Section IV - Limitations). The Service neither designed or intended the program to produce legal or regulatory products. Unintended use of the information or products is discouraged.

III. SERVICE AND NATIONAL PROGRAM STANDARDS

Mapping involves a number of functions including feature identification, classification, methods for data capture and storage, generation of map products in hard copy and digital formats, procedural documentation, and application of technology. Each function requires a level of standardization to produce consistent products.

Wetland Classification

The Fish and Wildlife Service uses the Cowardin *et al.* (1979) definition of wetland. This definition is the standard for the agency, and is the national standard for wetland mapping, monitoring, and data reporting as determined by the Federal Geographic Data Committee on December 17, 1996. It is a two-part definition:

> *Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water.*
>
> *For purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes, (2) the substrate is predominantly undrained hydric soil, and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year.*

This classification system was adapted for mapping purposes (see Part 2. Technical Specifications). The minimum standard is classification to all three of the following levels: ecological system, subsystem (where applicable), and class. Other identifiers may be added to satisfy more regional needs including subclass, water regime modifiers, water chemistry modifiers, soil modifiers, special modifiers, and other descriptors.

[1] Reconnaissance level mapping is constrained by remote sensing methods employed (not to species level), time and cost of data collection.

Deepwater Habitats
Wetlands and deepwater habitats are defined separately by Cowardin *et al.* (1979) because the term wetland does not include deep, permanent water bodies. Deepwater habitats are permanently flooded land lying below the deepwater of wetlands. Deepwater habitats include environments where surface water is permanent and often deep, so that water, rather than air, is the principal medium in which the dominant organisms live, whether or not they were attached to the substrate.

Riparian Habitats
Riparian habitats are among the most important vegetative communities for western wildlife species. Because of its expertise in wetland identification and mapping, the Service has been asked with increasing frequency to map riparian areas of the western United States. The Fish and Wildlife Act of 1956 authorized the Service to map habitats used by fish and wildlife resources. Under that authority, the Service developed and implemented "A System for Mapping Riparian Areas in the Western United States" (USFWS 1997). The Services riparian mapping system has been applied to several efforts to locate and describe this unique vegetative community in the western United States. The Service's riparian definition is:

> *Riparian areas are plant communities contiguous to and affected by surface and subsurface hydrologic features of perennial or intermittent lotic and lentic water bodies (rivers, streams, lakes or drainage ways). Riparian areas have one or both of the following characteristics: 1) distinctively different vegetative species than adjacent areas, and 2) species similar to adjacent areas but exhibiting more vigorous or robust growth forms. Riparian areas are usually transitional between wetland and upland.*

Upland Habitats
Historically, all areas not mapped as wetland or deepwater were labeled as "upland" on the Service's wetland maps. New technologies negate the need for labeling of non-wetland areas and consequently are considered upland by default. Some habitat mapping projects may require more specialized upland classification. For these projects, the Service has grouped upland habitats into five generalized categories which may be combined or further subdivided as needed for specialized mapping efforts. The categories for upland at the broadest scale are: ***agriculture***, ***urban*** and ***other upland***. These have been adapted from the U. S. Geological Survey (USGS) land classification scheme described by Anderson *et al.* (1976). ***Forested plantations*** and ***rural development*** categories have been adopted by the Service, vetted through interagency review, and are used in further describing upland areas.

Metadata
Metadata are the supplemental information used to document digital data content and source. The Service uses the Federal Geographic Data Committee (FGDC) Content Standards for Digital Geospatial Metadata (CSDGM), also referred to as FGDC-STD-001-1998. On August 20, 2003 the Service established a procedural standard for documenting biological metadata.

Geospatial Data Standard

Digital wetland data from the Service's geodatabase complies with the Service's Standards for Geographic Information Systems (FWM# 406, 270 FW 8) and the Data Management Standards (FWM# 406, 270 FW 6).

Digital wetlands data are provided in a personal geodatabase format. Wetlands digital data will be provided in a uniform projection (Albers Equal-Area Conic Projection) for each of the five mapping areas that compose the U.S. (conterminous U.S., Alaska, Hawaii, Puerto Rico and the U. S. Virgin Islands, and the Pacific Trust Territories. The Albers Equal-Area Conic projection is frequently used for a variety of digital spatial data sets published by both the Service and the USGS. The horizontal planar units are meters and the horizontal planar datum is the North American Datum of 1983, also called NAD83.

Standards for the U. S. Geological Survey published digital spatial data were used to define the standard parallels, central meridians, and latitudes of origin for each wetland mapping area contained within the Service's wetlands geodatabase.

Geographic data are stored as polygons and lines. In early edition wetlands maps, small wetland features were represented as points. These points were an artifact of the scale limitations of the cartographic technology used to map the wetlands. The use of modern digital technology and on-screen mapping of wetlands allows interpretation to be done at a much larger scale. Features previously represented as points are delineated as polygons. Existing features previously digitized as points will be maintained in the geodatabase, but buffered to small (0.10 ac) polygon size.

Data management and electronic transfer and storage of data shall conform with applicable Service information resources management policies and procedures, or with applicable American National Standards.

Standard (Hardcopy) Map Product

The standard map product has been large-scale maps 1:24,000/1:25,000 scale for all areas, except Alaska where 1:63,360 scale is the USGS base map standard[2]. The wetland maps were produced as topical overlays using USGS topographic maps as the base. The product is a composite map showing topographic and planimetric features from the USGS map base and wetlands and deepwater habitats from the Service's topical overlay.

Current geographic information system technology, and advances in computerized mapping, have enhanced the capability of the Service to display wetland information. However, the Service will maintain a nationally consistent, standardized hard copy map product. This will be

[2]Some small scale (1:100,000 and 1:250,000) wetland maps have been produced by the Service. These are considered special or custom map products.

produced using either the USGS digital raster graphic as the topographic base map (1:24,000 or 1:25,000 scale or to 1:63,360 for Alaska) or the digital orthophotography (same scale) with the wetlands and deepwater habitat information as a topical display. These maps are Service products, and will display the Service logo, and contact information. They should not exceed overall dimension of 61 cm wide and 72 cm long (24 x 28 inches). Print on demand maps should be produced on good quality, stock, white paper and must contain the following information as a cartographic standard:

Collar Notes and Other Marginal Data

This section concerns the requirements for correct phrasing and standardized treatments for collar notes on maps. Where possible USGS standards been used (USGS 2001).

- **Standard Service Visual Identity Logo**
  Place the Service visual identity logo in the upper left margin:

- **Department/Bureau Identifier**
  Place the Department/Bureau identifier in the upper left margin to the right of the visual identity logo:

  U.S. DEPARTMENT OF THE INTERIOR
  Fish and Wildlife Service

- **Map Title Block, Upper Right Margin**
  Show the quadrangle name on the first line of the map title block in the upper right margin, the State(s) and county (if applicable) name in which the quadrangle lies on the second line. Use only standard USGS quadrangle names for quadrangle maps. If the map depicts an area other than a quadrangle, obtain the quadrangle name from the Geographic Names Information System (GNIS). Append the word "QUADRANGLE" after the quadrangle name. It is permissible to abbreviate quadrangle names because of space limitations or to conform to local or legal usage. If the quadrangle is in more than one State, list first the State containing all or the larger part of the feature for which the map is named, and list the other States in descending order by area within the quadrangle.

- **Source Notes**
  Source notes indicate the currentness of map content. Source notes may also credit agencies for maintaining and contributing data that the Service does not verify or recompile.

  If the map data was compiled from imagery, use the year of the imagery as the currentness date on the revised map. If there is a range of imagery years, use the oldest year.

Derived from imagery taken 1998 and other sources.
Field checked 2000.

- **Horizontal Coordinate Reference System Notes**
  Horizontal coordinate reference system notes identify the system used to reference locations on the ground. All updated maps are plotted on the Universal Transverse Mercator projection and North American Datum of 1983:

  North American Datum of 1983 (NAD 83):
  Universal Transverse Mercator Projection

- **Explanatory Notes**
  Explanatory notes describe specific features that appear in the body of the map. Unless otherwise stated, the following explanatory notes have been presented in their preferred order:

  Web reference to classification or legend
  Contact information
  Specialized disclaimers

- **Declination Diagram**
  The declination diagram graphically depicts the direction of deviation of the UTM grid north and magnetic north from true north.

- **Map Scale Note and Bar Scale**
  The map scale is a recognized way of referencing map series. The map scale note (representative fraction) may be used to relate map measurements to ground distances. Pattern the appropriate map scale note after the following:

  SCALE 1:24 000
  Show the bar scale below the map scale note in both English and metric units.

- **Custom Information (if appropriate)**
  Amend the for sale note when a State or Federal cooperating agency maintains a distribution center for maps falling within its sphere of interest and requests mention. Reference the cooperating agency by name and address (city, State, and ZIP code).

  For Sale By: South Dakota State University
  Brookings, SD 57007

- **Neat Line**

- **Geographic Coordinates**
  Show the geographic coordinates in degrees/minutes/seconds at the corners.

- **Quadrangle Location Diagram**
  The quadrangle location diagram can be used to generally locate the quadrangle within a State. If a quadrangle falls in two or more States, show the outline of the State having the feature for which the map is named.

Specialized or custom maps may be produced to depict specific project areas or different geographic settings. These maps should retain as much of the standard information listed above as possible given any size and content differences.

Technical Reports
Technical reports, whether produced in hard or soft copy, must comply with the Service's Graphic Standards and Format for Publications (USFWS 2000). Technical or scientific reports made available digitally through the Service's web site, on CD or published in hard copy, must comply with the project's Information Quality Guidelines.

IV. LIMITATIONS

Exclusions - Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and near shore coastal waters. The detection of submerged aquatic vegetation using aerial imagery is difficult without extensive surface-level observations, tide-stage data, water-clarity data and because of surface waves (Ferguson et al. 1993).

Reefs include tropical reef communities (coral or tuberficid worm reefs), Oyster (*Crassostrea virginica*) reefs, and artificial reefs. Reef communities form a vital component of coastal ecosystems. Tropical coral and worm reefs can be found in the Florida Keys extending south from Miami and Soldier Key to the Dry Tortugas, Puerto Rico, the U.S. Virgin Islands, Hawaii and the islands of the Pacific Trust Territories. Oyster reefs can be found in several states along the south Atlantic and Gulf coasts. Artificial reefs may be found in almost any coastal offshore waters. Reefs are found offshore in water depth from less than 1 m to over 40 m. Because of their depth, most reefs go undetected by aerial imagery used to map wetlands (Dahl 2000).

Cowardin *et al.* (1979) does not recognize ephemeral water areas as a wetland type. Therefore, ephemeral waters are not included as part of this mapping effort. Different agencies describe

"ephemeral wetlands" in different ways. Ephemeral waters, as referenced here, are areas that are flooded or ponded with surface runoff for less than seven days. Wetlands such as what EPA refers to as seasonal ponds, temporary ponds or vernal pools (U.S. EPA www.epa.gov) are included as wetland types in the Service's mapping efforts.By policy, the Service also excludes certain types of "farmed wetlands" as may be defined by the Food Security Act or that do not coincide with the Cowardin et al. definition. Contact the Service's Regional Wetland Mapping Coordinator for additional information on what types of farmed wetlands are included on wetland maps.

Minimum Mapping Unit - Wetlands

At the start of the Service's operational wetland mapping program, the most widely available aerial photography was 1:80,000 scale, panchromatic (black and white), although some photography as small as 1:130,000 scale was used for mapping wetlands. On these early maps, the targeted minimum mapping unit (i.e., the smallest feature consistently mapped) was 3.0 - 5.0 acres. The establishment of the National High-altitude Aerial Photography Program in the early to mid 1980s, acquired 1:58,000 scale, color infrared photography and changed the minimum size wetland that could be mapped. Using the 1:58,000 scale photography, the targeted minimum wetland for mapping was changed to range from 1.0 to 3.0 acres. The NHAP program was subsequently replaced with the National Aerial Photography Program that acquired 1:40,000 scale, color infrared and/or panchromatic aerial photography.

Seasonally flooded to permanently flooded wetlands are generally easier to identify using aerial imagery than drier types (temporarily flooded and saturated). Also, wetlands in open areas (e.g., prairies or grasslands) are easier to identify than wetlands under thick forested canopies or forested wetlands within a wetland-upland forest matrix. Wetlands are dynamic systems that may sustain several years of drought conditions making difficult to identify and map simply because they are not detected on aerial imagery. Wetlands smaller than the "targeted minimum mapping unit" referenced above, may be included on any era wetland map. Actual mapped features on some wetland maps indicate that for some wetland types, the minimum size represented was less than 1.0 acre. However, not all wetlands less than the targeted size category were detected consistently across the Nation.

Currently, the minimum mapping unit for standard National Wetlands Inventory maps is 1.0 acre. Special mapping projects may exceed this target.

V. QUALITY REQUIREMENTS FOR WETLANDS AND DEEPWATER MAPS

There are no absolutes in wetlands mapping. Precise wetland boundaries are often hotly contested using the best technological and scientific tools. There is also no answer key with which to compare wetland maps to evaluate completeness and accuracy. The Service possesses considerable expertise and experience in the identification and classification of Cowardin-type

wetlands. Using this expertise, the Service has determined that the following minimum requirements must be met for the wetlands map data to be qualitatively acceptable. They reflect the overall intentions and direction of the organization as regards to quality, and as formally expressed by top management.

Wetlands and Deepwater Habitats - Level of Accuracy

Identification - The Service's current minimum mapping unit for wetland is 1.0 acre. Maps must depict 95 percent of all wetlands 1.0 acre or larger to be considered qualitatively acceptable.

Classification - Cowardin *et al.* (1979) is the Service's and a National standard for mapping wetlands. Maps must classify 95 percent of the wetlands to the Cowardin Class level to be considered qualitatively acceptable.

Geo-positional Accuracy - Geo-positional accuracy relates to the delineation of the wetland on the landscape. Wetlands and wetland boundaries must be within 10 meters (33 ft.)of their true location to be qualitatively acceptable.

Edge Matching - Every effort must be made to ensure wetland map data are seamless. For maps produced in the same era or edition, work areas should be edge-matched so that 100 percent of the classification attributes for adjacent features agree, and delineations for adjacent features are within 10 meters of their true location.

Metadata Requirements - Mandatory metadata requirements include the completion and submission of the following items in electronic form:

- Supplemental Map Information (User Report)
- Regional Transmittal Form

VI. TECHNICAL PROCEDURES FOR WETLAND AND DEEPWATER HABITAT MAPPING

Operational techniques and options of how best to attain the quality requirements are discussed in Part 2 - Technical Specifications.

VII. MANAGEMENT TASKS RELATING TO QUALITY CONTROL

PRACTICES

Management activities and tasks are integral to effective quality control practices. They are the aspects of the overall management function that determine and implement the quality control policies and guidelines. They are to be administered by the Chief, Branch of Habitat Assessment:

- Coordinate with senior management
- Manage and coordinate the quality control system and related processes
- When necessary, act as liaison to settle disputes on matters of quality control or policy
- Manage organization resources designated to support quality assurance
- Maintain records of pertinent quality control activities
- Ensure that all changes to the guidance documents are available to all personnel using that guidance, including active contractors and cooperators
- Review and approve quality control documentation
- Review and approval those papers and reports that meet the Information Quality Guidelines for publication and dissemination
- Oversee data management and storage processes
- Ensure that project quality control personnel are adequately trained and qualified

The implementation of quality management activities including limitations on the use of extramural support agreements to implement quality control operations and reporting requirements are presented below:

Two types of quality management functions are described:

- Exclusively Service Functions - inherently governmental work which must be performed only by responsible Service personnel. These functions include:

  Project implementation
  Master geodatabase data requests
  Project conventions or protocol revision or development
  Regional quality control and certification
  National quality control review
  Data delivery to Master geodatabase
  Master geodatabase administration
  Public interface

- Discretionary Functions - Work performed on behalf of Service through appropriate extramural agreements shall comply with the data quality requirements. Discretionary activities that may be performed either by Service personnel or by non-Service personnel under the specific technical direction of and performance monitoring by a Government official under an approved contract,

work assignment, delivery order, task order, etc. Such functions include:

Field verification/reconnaissance
Image interpretation and initial quality control
Data capture
Image rectification
Internal reporting (trip reports, metadata, etc.)
Other functions as specified by task assignment

Dispute Resolution - Oversight responsibilities for QA and QC activities may sometimes result in disagreements between the oversight person or group and the originating image analysts regarding the mapping results. Such disputes may involve technical issues (e.g., data quality, reliability of collateral data, quality reviews, etc.) and management issues (e.g., available technology, management systems or personnel). In situations where technical issues regarding QA and QC activities are in dispute, resolution should be sought at the lowest management level practicable. All parties should make every effort to resolve disputes through discussion and negotiated resolution. If unsuccessful, final resolution will be made by the senior manager for the organization.

Service Personnel - Qualifications and Training
Service personnel are responsible for conducting technical assessments of quality. The Service will use only fully trained, experienced and technically proficient personnel for this function. The interpretation and mapping of wetlands and other aquatic habitats to meet Service standards is a highly specialized discipline. With the advent of newer mapping technologies, image analysts need to possess additional skills and knowledge of such things as computerized mapping systems, geographic information technology, characteristics of various remote sensors, wetland ecology, wetland classification and land use. The "Technical Procedures for Wetland and Deepwater Habitat Mapping" discuss the requirements for personnel depending on specific techniques employed to map wetlands (i.e. stereo vision for those using stereoscopic techniques).

Management can ensure that data and product quality requirements and the performance of personnel are satisfactory by monitoring and verification of the status of procedures, methods, conditions, processes, products, services and analysis of records in relationship to the specified requirements.

VII. REFERENCES

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